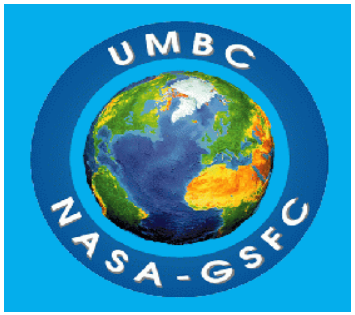

AIRS Science Team Meeting Feb. 25, 2003

A quick look at retrievals over Brazil

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The Basic Retrieval Equation

For discussion, assume a retrieval equation looks like

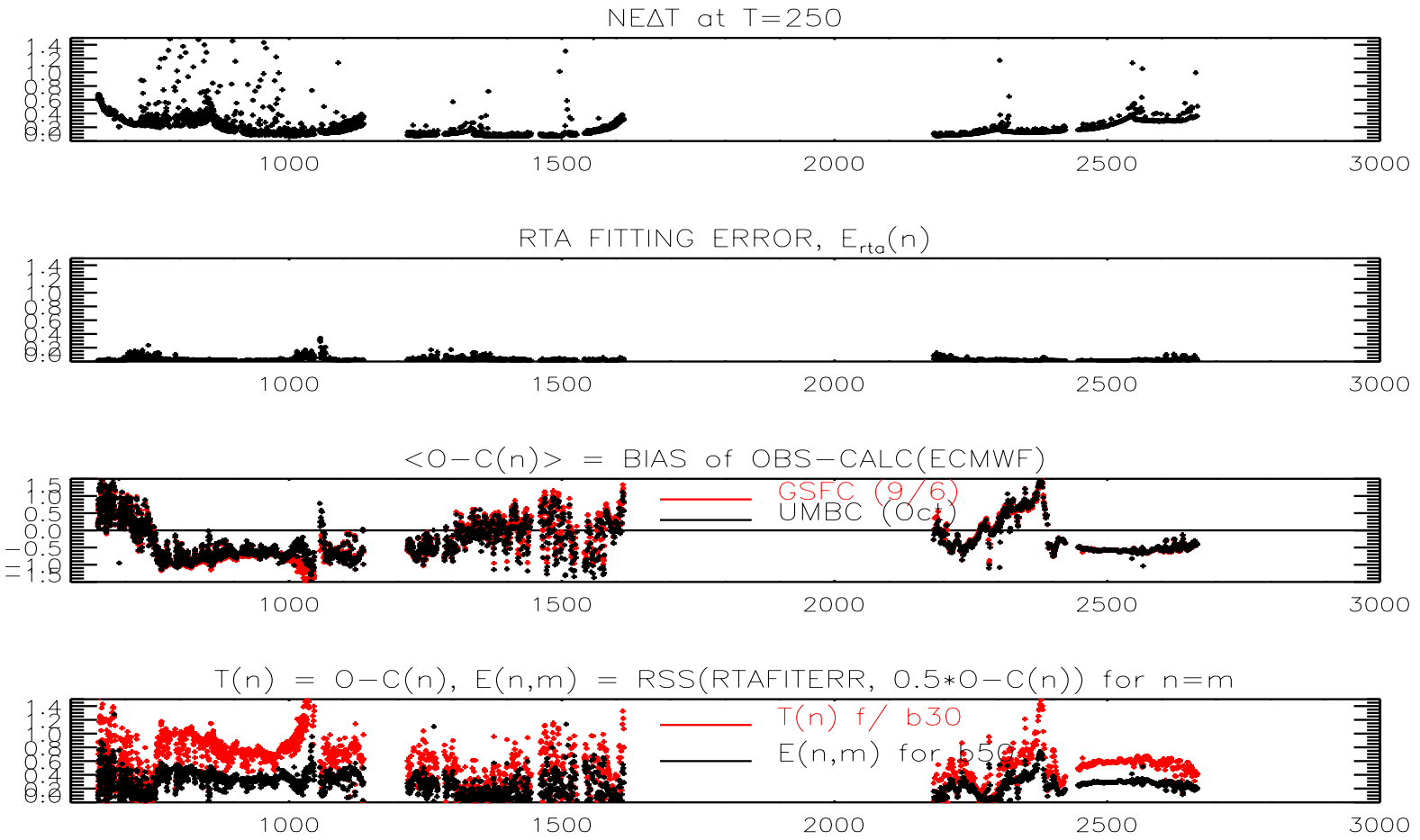
$$\Delta X_i = \left[S'_{i,n} \cdot W_{n,m} \cdot S_{m,j} + H_{i,j}\right]^{-1} \cdot S'_{j,m} \cdot W_{m,n} \cdot (O - C(n) + T(n)) \quad (1.1)$$

where, n and m are channel indices, $S_{n,i}$ is the sensitivity of channel n to parameter i (or j), $O - C(n)$ is the observed radiances minus the radiances computed from the current state of X. $T(n)$ is radiance tuning, if applied.

The weighting matrix, $W_{n,m}$ is derived from the covariance of instrument and geophysical errors, $N_{n,m}$ that are a strong function of cloudiness due to the linear combinations imposed by cloud clearing. In addition, we could have other error sources, such as RTA and spectroscopy errors, $E_{n,m}$.

$$W_{n,m} = [N_{n,m} + E_{n,m}]^{-1} \quad (1.2)$$

Biases of O-C



BIASES of O-C were determined by comparison of AIRS with ECMWF computed radiances for CLEAR, OCEAN, NIGHT conditions. Infrared appears to be stable in Sep. and Oct.

Tuning versus Error Terms

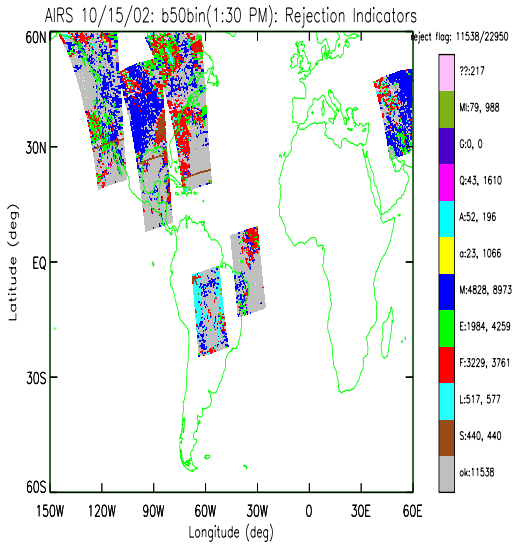
- **If $E(n,m) = 0$ then we believe $O - C(n) - T(n)$ which means the retrieval assumes very low errors**
- **If $E(n,m) \neq 0$ then**
  - **$O - C(n)$ is not believed entirely**
  - **AMSU & AIRS convergence is relaxed $\Rightarrow$ greater yield.**
- **Experiments with INFRARED TUNING set to $\overline{O - C(n)}$ and experiments with the error term set to $\overline{O - C(n)}$ have similar results – when this is the only change applied!**
- **Since biases on obs-calc's, $\overline{O - C(n)}$ has both forecast errors and spectroscopy/instrument errors we attemped an experiment with only the diagonal error term specified**

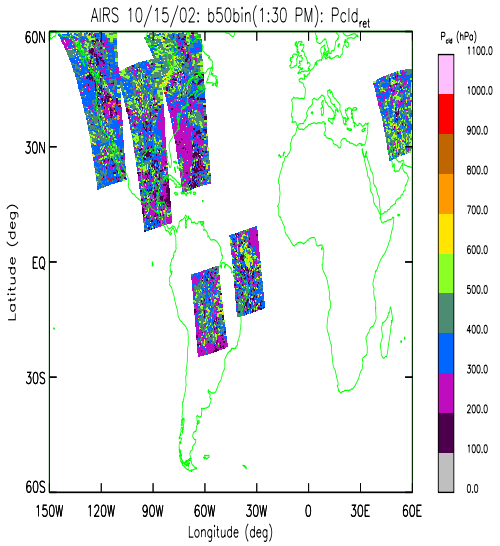
$$E_{n,n} = \left(\frac{\overline{O - C(n)}}{2}\right)^2 + E_{rta}(n)^2 \tag{1.3}$$

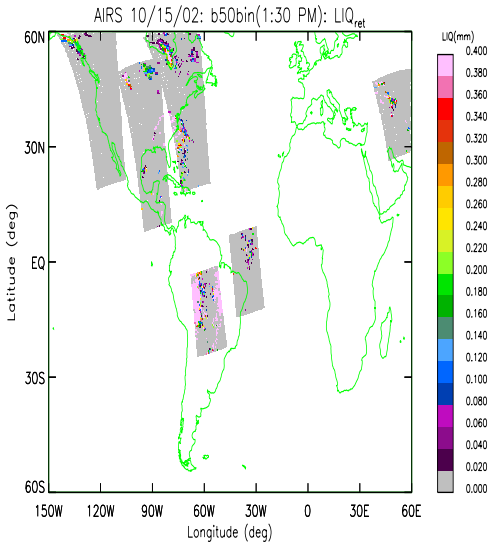
Conclusions about INFRARED tuning

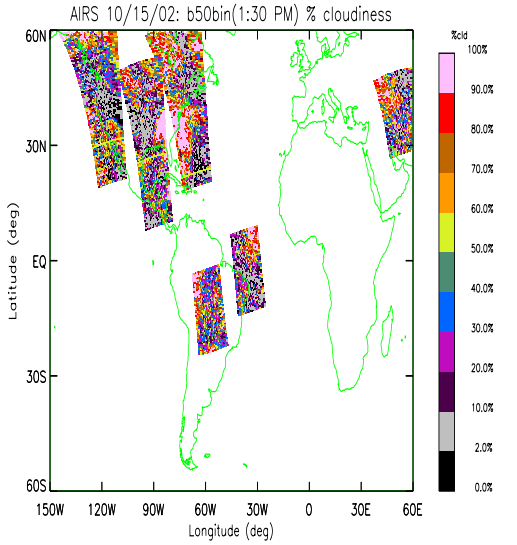
- **All experiments done to date used a simple BIAS tuning for the microwave.**
- **We recently fixed two BUGs with the MICROWAVE tuning in which we inadvertantly set HSB tuning equal to AMSU's tuning with the opposite sign T(HSB) = -T(AMSU) $\Rightarrow$ Statistics of 70 granules within $\pm$ 60° latitude on 9/6/02 with and without this BUG are VERY similar.**
- **While global and statistical views have value, it is also IMPERATIVE that we look at individual & independent validation cases to determine issues w/ regard to tuning.**
- **I ran $\approx$ 2500 granules with $T(n) = 0$ and $E(n, m)$ specified by Eqn. 1.3 from 8/31/02 to 11/30/02 to look for trends and provide retrievals at validation sites in the US and Brazil.**
- **Tomorrow these retrieval results will be compared to coordinated in-situ during $\approx$ 90 AQUA overpasses**

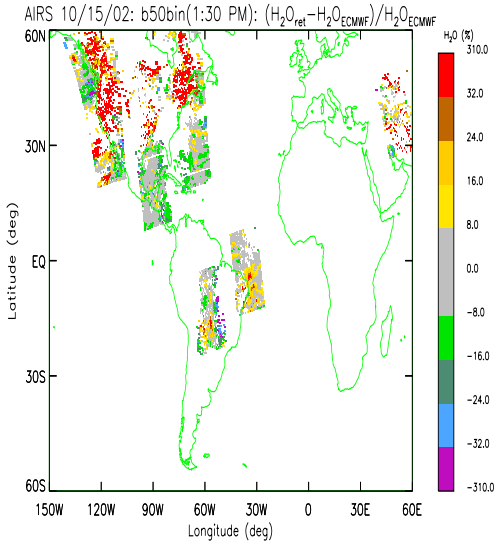
Oct. 15, 2002: 1:30 p.m.

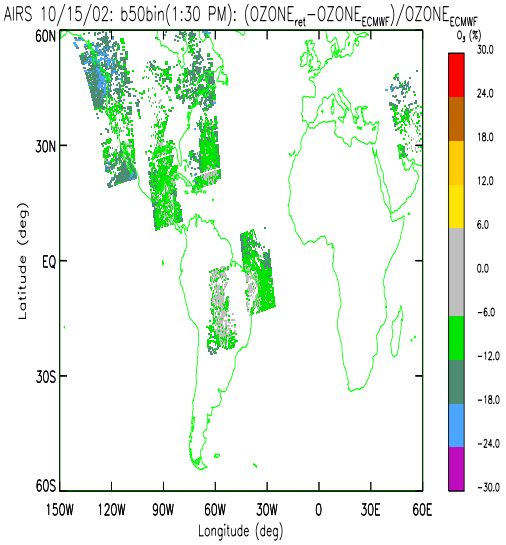




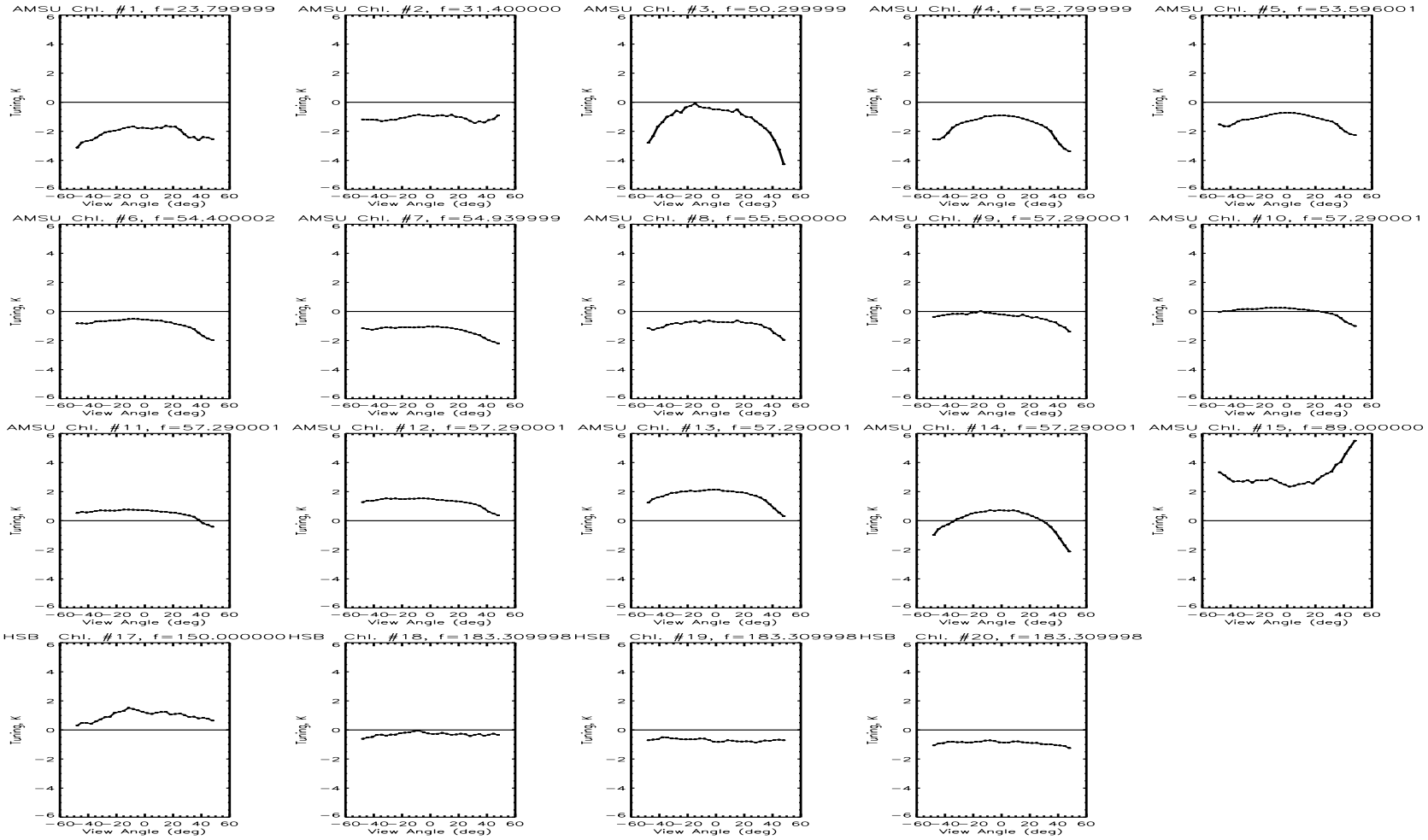






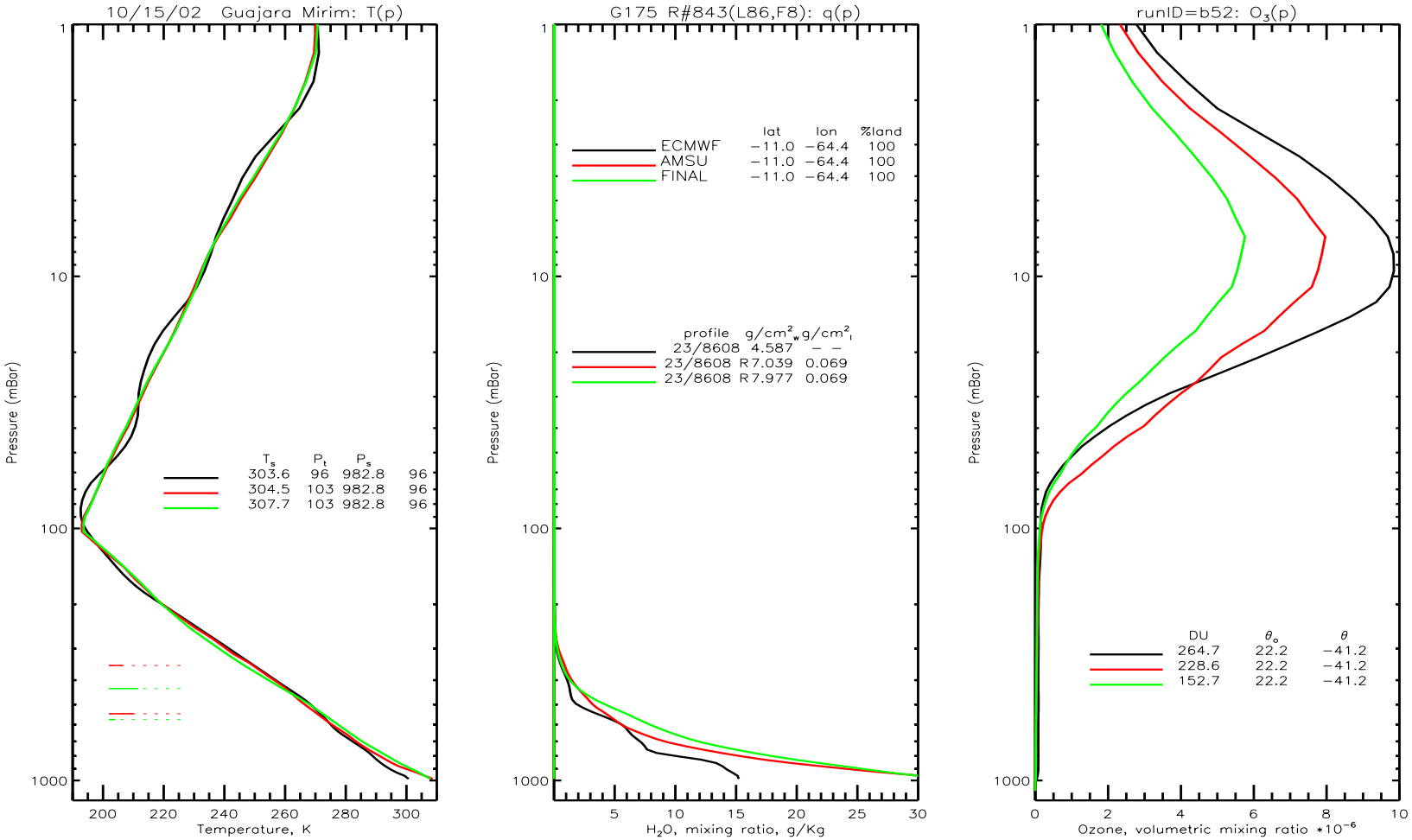


Microwave Tuning



Microwave tuning determined from ≈ 45,000 cases from Sep. 6, 2002. Cases were restricted to ± 60 latitude, OCEAN, and NO Liquid water.

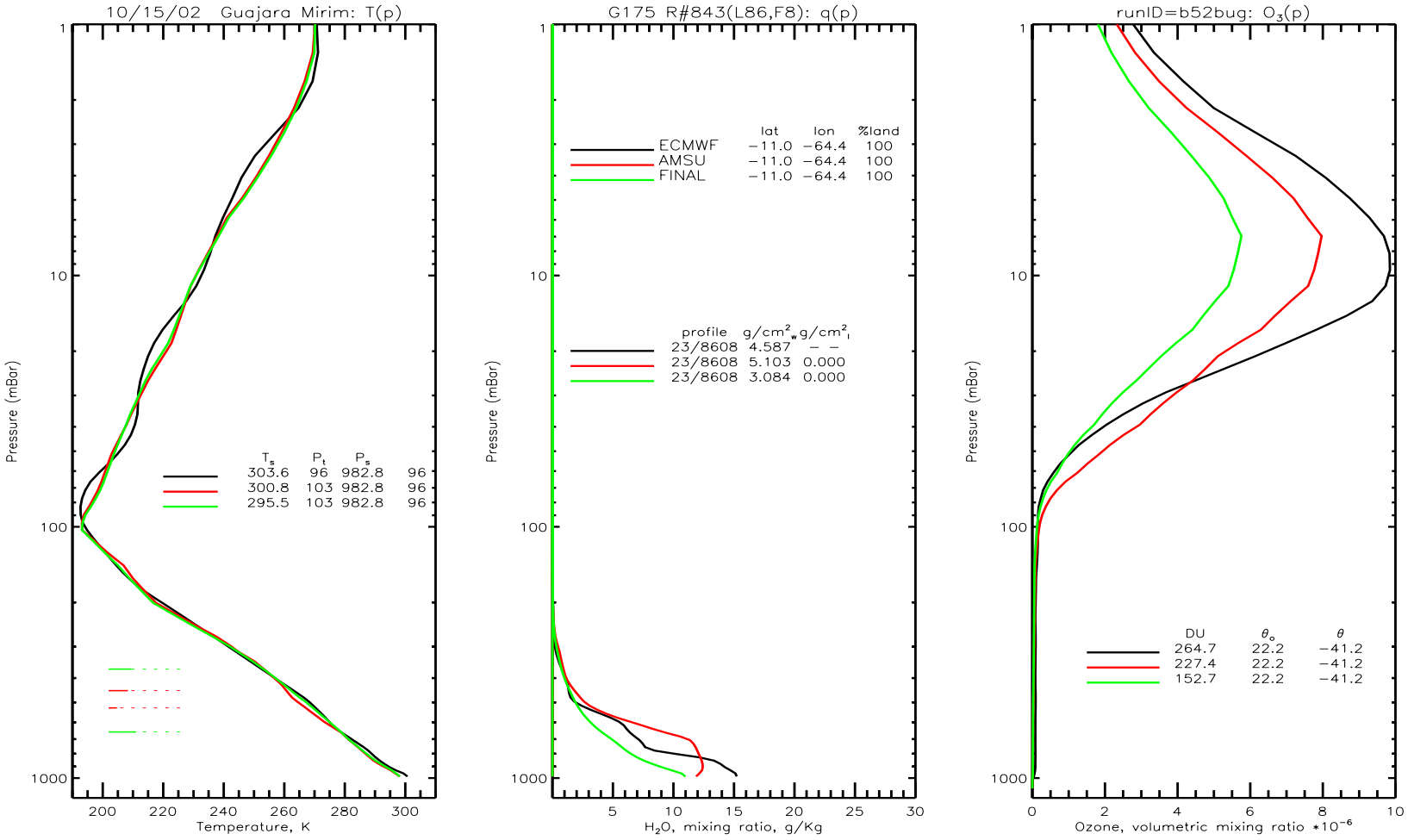
Guajara Mirim, Oct. 15, 2003



Baseline run ("b50" w/ HSB T(n) BUGS fixed) using T(n)=0, E(n,n) is set as in Eqn. 1.3.

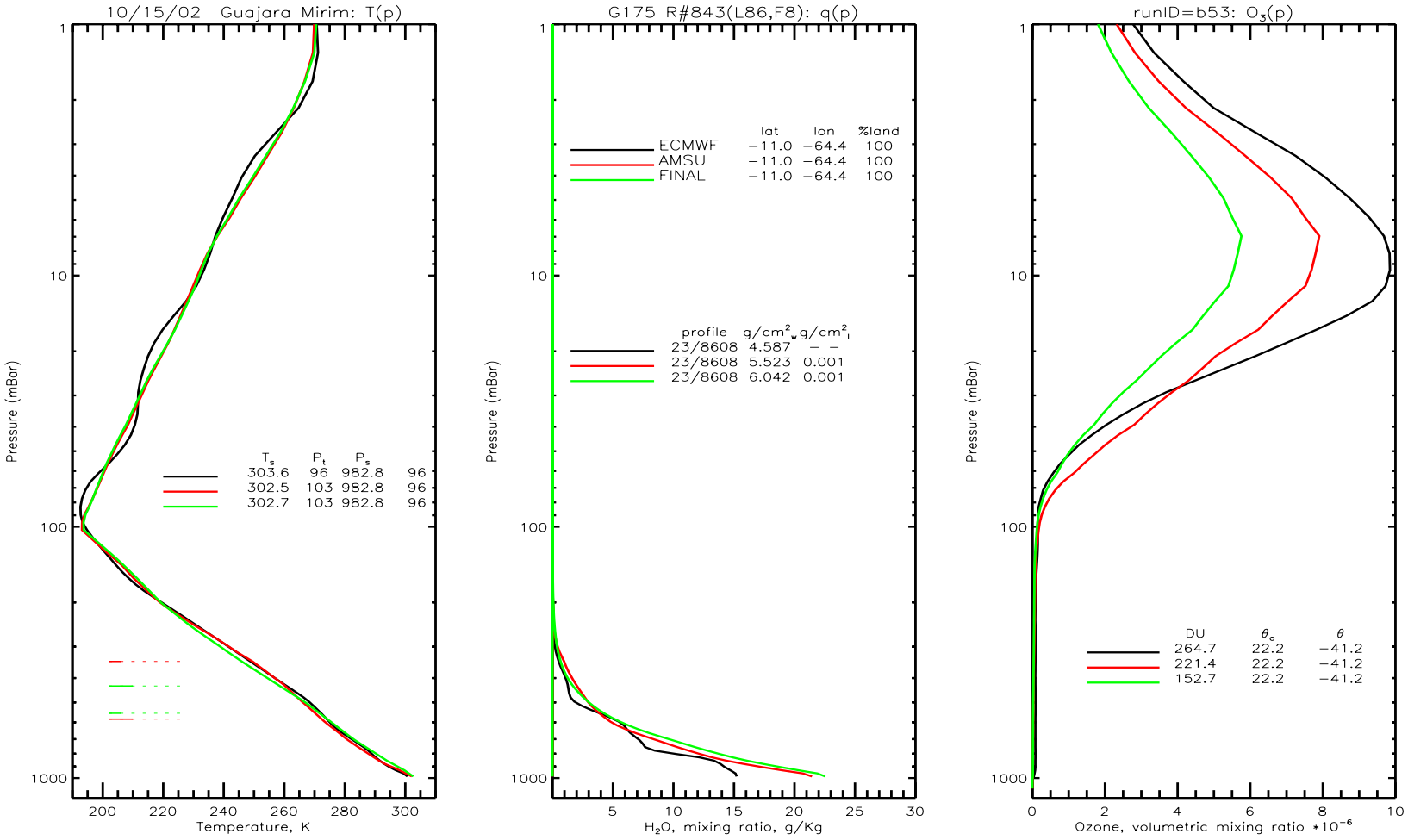
NOTE: problem w/ q(p) and large L(p). Also, q(p) never exceeds saturation

Guajara Mirim, Oct. 15, 2003



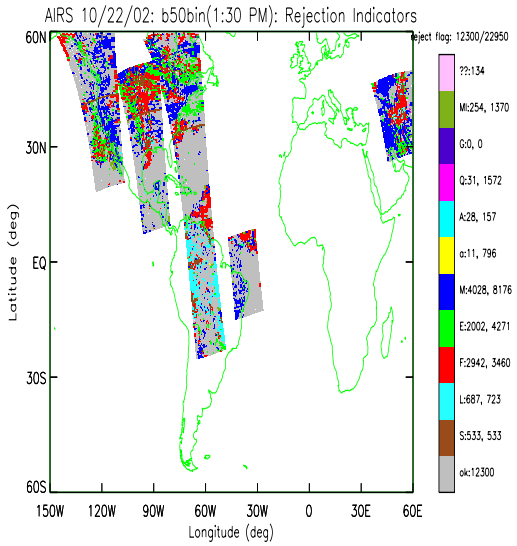
Baseline run w/ HSB T(n) BUGS re-installed. NOTE that L(p) is zero here. This emulates a "b30" system w/o TUNING

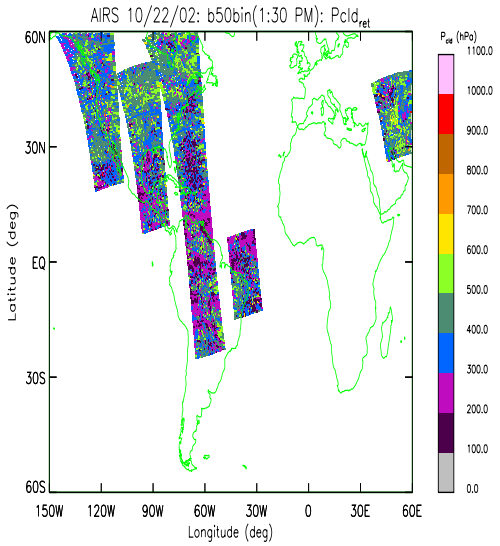
Guajara Mirim, Oct. 15, 2003

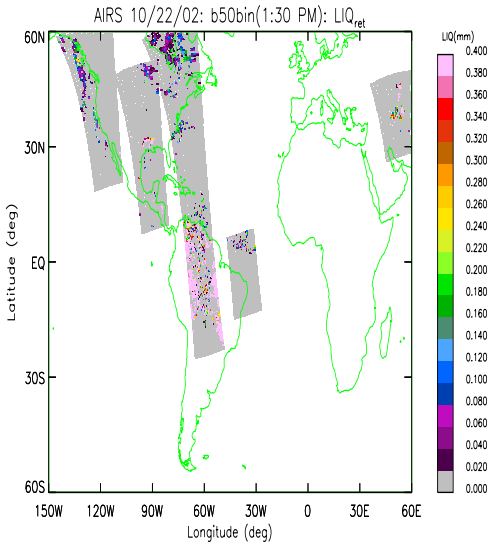


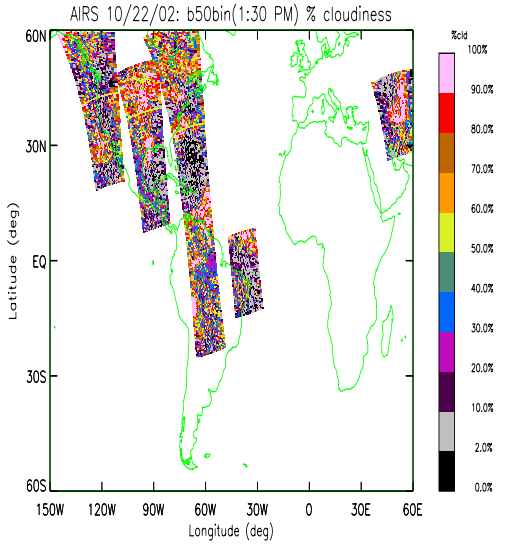
Baseline + removed microwave channels from all q(p) steps (including MIT).

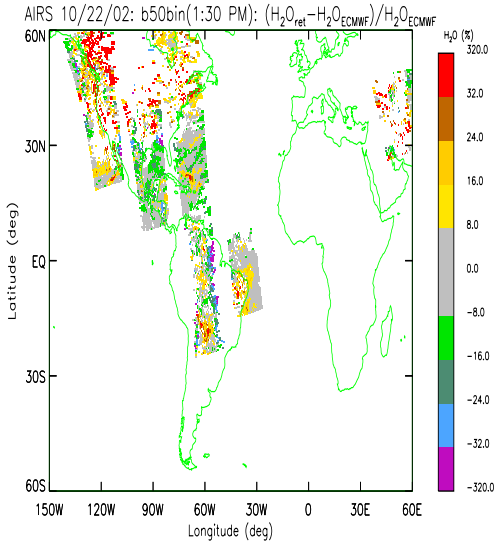
Oct. 22, 2002: 1:30 p.m.

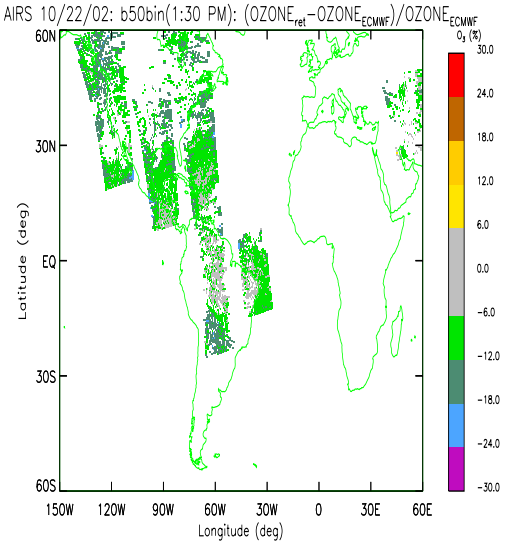




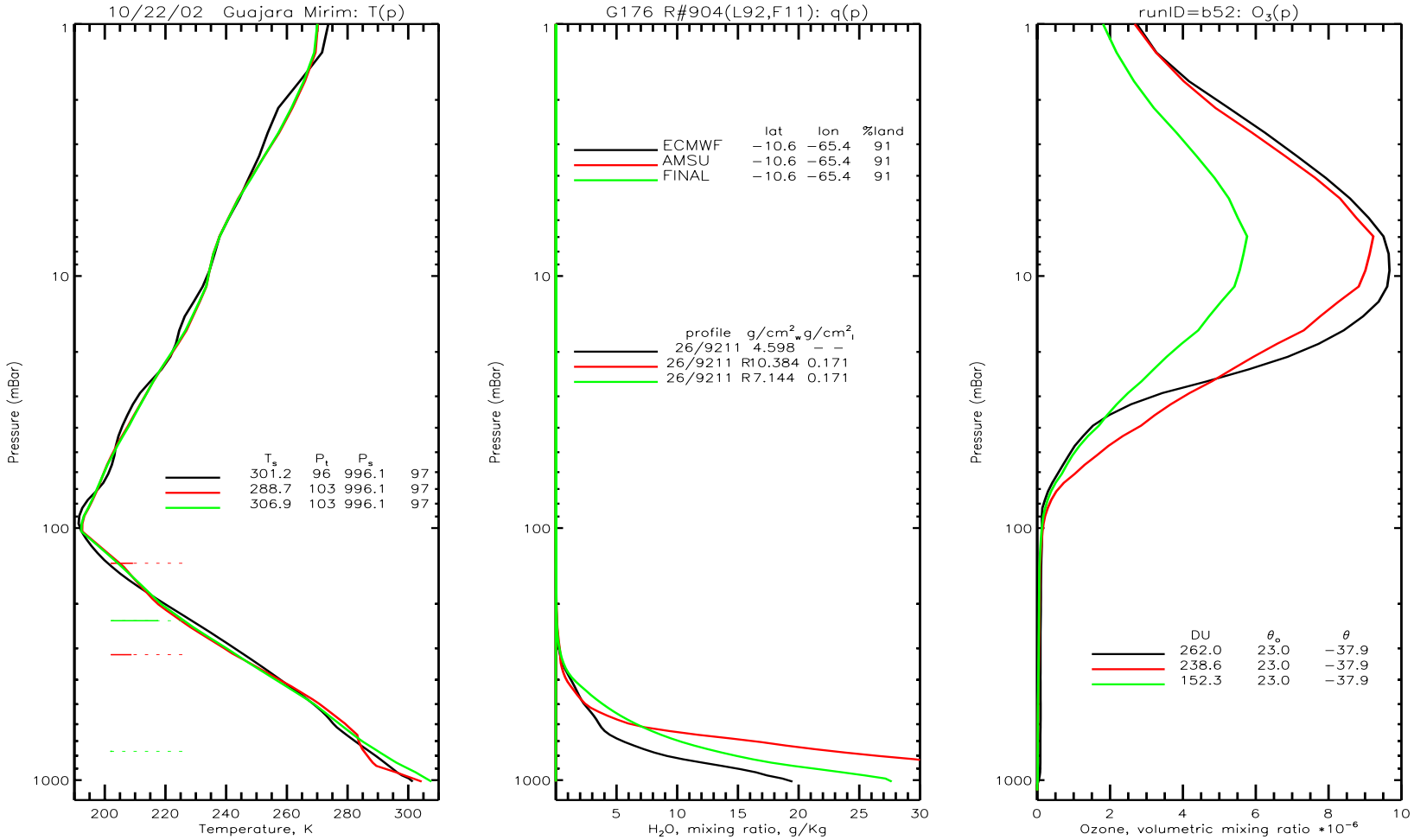






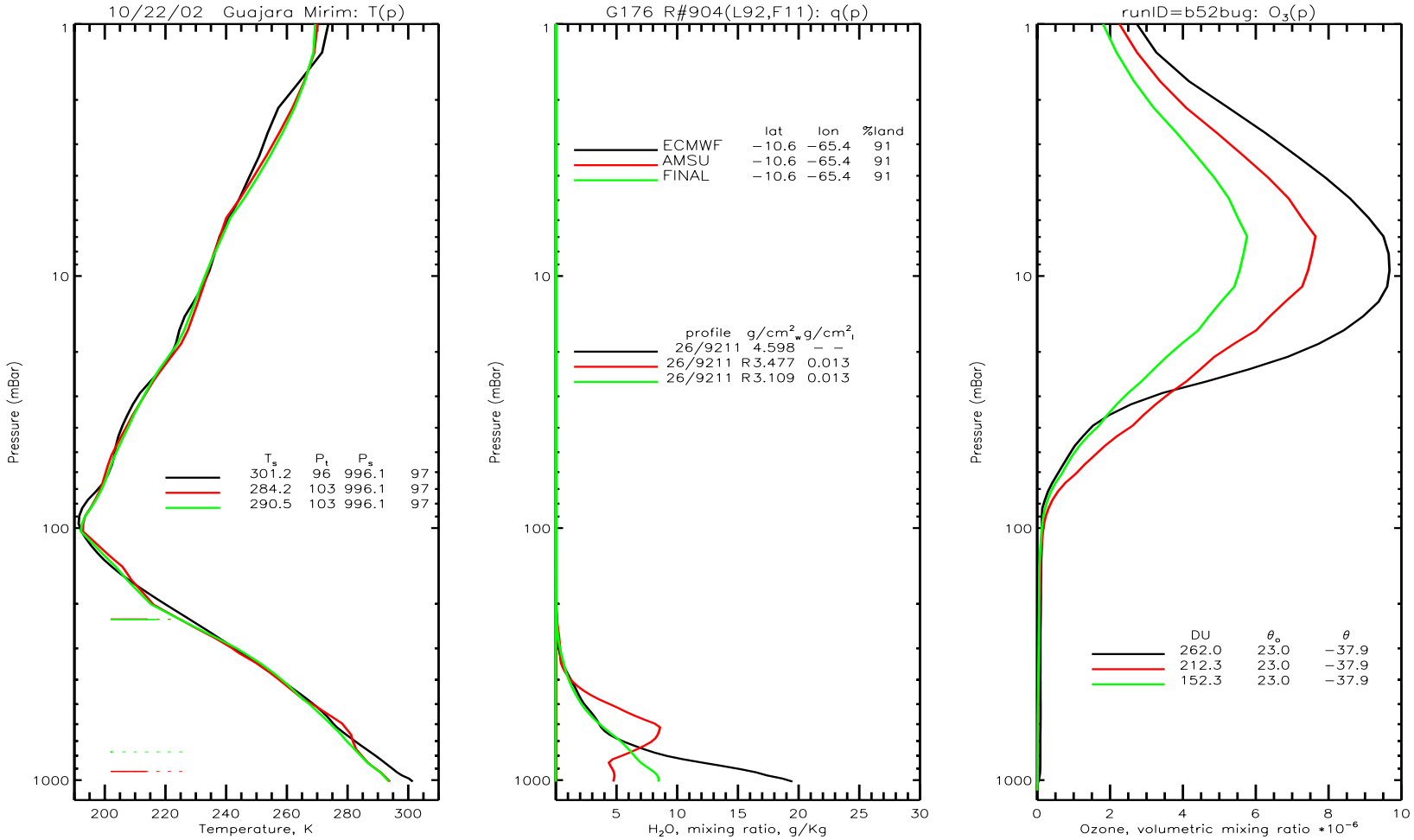


Guajara Mirim, Oct. 22, 2003



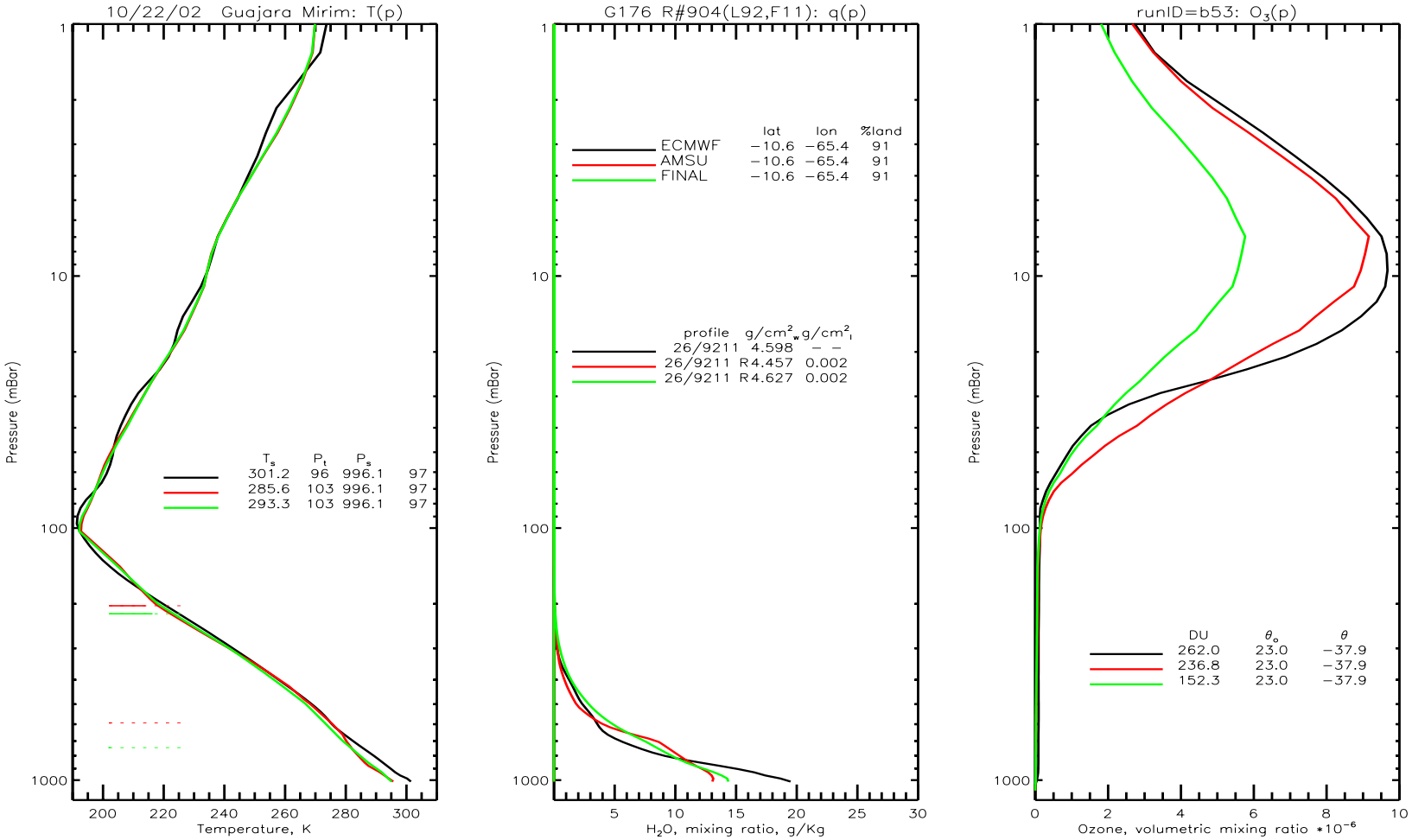
Baseline run (all known BUGS fixed) using T(n)=0, E(n,n) is set as in Eqn. 1.3

Guajara Mirim, Oct. 22, 2003



Baseline run w/ HSB T(n) BUGS re-installed. NOTE that L(p) is zero here. This emulates a "b30" system w/o TUNING

Guajara Mirim, Oct. 22, 2003



Baseline + removed microwave channels from all q(p) steps (including MIT).

Water Retrieval Conclusions

- "Correct" tuning causes MIT water vapor retrieval to exceed saturation and to have large liquid water. MIT retrieval does not reject these cases.
- ..or.. HSB tuning is a function of land/ocean or a function of moisture.
  - errors in forward model could be water dependent.
  - Earth shine on platform?
- In simulations we set a rejection criteria for Liquid Water $\geq$ 0.3 mm. This may be unnecessary.
- Infrared water retrieval is having a difficult time converging with HSB. The cloudier it gets, the more HSB is believed.
- I suggest we spend time with each and every case with coordinated observations during overpasses. There is a wealth of information to be gained from these difficult cases $\Rightarrow$ need to work in an interactive manner with validation groups.